

Unit Analysis

IB PHYSICS | SCIENCE SKILLS

Welcome to IB Land!

Since this course is *International* all of the units must be in the "European" format rather than the "American" format

This means that instead of writing units with a fraction slash, we must use negative exponents

7 m/s		$6.67 \frac{\text{Nm}^2}{\text{kg}^2}$	
9.81 m/s^2		$2.2 \frac{\text{J}}{\text{K}}$	
87 g/cm^3		$8.31 \frac{\text{J}}{\text{K} \times \text{mol}}$	

Dimensional Analysis

We can use equations with units that we know to find units that we don't.

$$p = m \times v$$

Variable	Unit
Momentum p	
Mass m	Kilogram [kg]
Velocity v	Meters per second [ms ⁻¹]

Dimensional Analysis

Constants have units too! That's what makes our equation valid

$$F = G \frac{m_1 m_2}{d^2}$$

Variable	Unit
Force F	Newton [N]
Mass m₁ and m₂	Kilogram [kg]
Distance d	Meter [m]
Universal Gravitation Constant G	

Dimensional Analysis

The units used, depend on the other values

$$Q = mc\Delta t$$

Variable	Value
Heat Energy Q	620 J
Mass m	
Specific Heat c	0.458 J g ⁻¹ K ⁻¹
Temp Change Δt	15 K

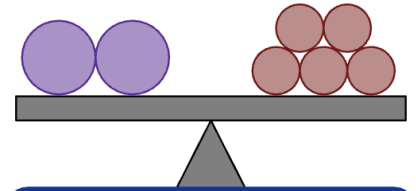
Remember Conversions? | 1

How many kilometers in 26.2 miles?

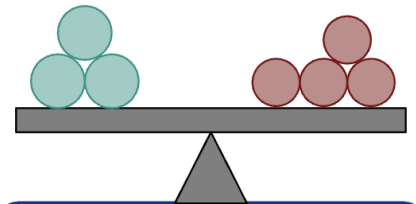
$$5 \text{ km} = 3.1 \text{ mi}$$

Remember Conversions? | 2

10 purple equals how many green?



$$2 p = 5 r$$



$$3 g = 4 r$$

Conversions to Memorize

1 m	=	1000 mm
1 m	=	100 cm
1 km	=	1000 m

1 day	=	24 hr
1 hr	=	60 min
1 min	=	60 s

Do these without a calculator:

$$45 \text{ cm} = \quad \text{m}$$

$$35.2 \text{ km} = \quad \text{m}$$

$$21 \text{ mm} = \quad \text{cm}$$

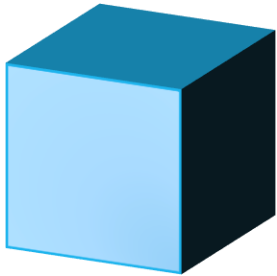
$$320 \text{ mm} = \quad \text{m}$$

Conversions with Exponents

How many cm^2 are there in 1 m^2 ?



How many cm^3 are there in 1 m^3 ?



Conversions with Exponents

Convert the Following:

$$5 \text{ mm}^2 \rightarrow \text{m}^2$$

Conversions

Prefix	Abbreviation	Value
peta	P	10^{15}
tera	T	10^{12}
giga	G	10^9
mega	M	10^6
kilo	k	10^3
hecto	h	10^2
deca	da	10^1
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}

Use the IB Table to make a conversion factor for the unfamiliar ones

$$1 \text{ prefix} = 10^{??} \text{ base}$$

$$1 \text{ MW} = \quad \text{W}$$

$$1 \text{ ns} = \quad \text{s}$$

$$1 \mu\text{g} = \quad \text{g}$$

Conversions

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hecto	h	10^2
deca	da	10^1
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}

64 MW \rightarrow W

0.00089 C \rightarrow μ C

256 nm \rightarrow m

Lesson Takeaways

- I can represent fractional units with negative exponents
- I can use dimensional analysis to determine unknown units from an equation
- I can convert units using dimensional analysis
- I can convert squared and cubed units